

CLAIMS

We Claim:

1. A heat exchanger apparatus comprising at least one single piece tubular member having a generally circular cross section, said tubular member further comprising a restricting and turbulating structure, said structure comprising at least one
5 opposing pair of obstructions having a generally parabolic dimple shape disposed within said tubular member and wherein the entire obstruction of each pair of obstructions are aligned with respect to each other and project into said tubular member until they
10 confront one another to form a pair of adjacent converging, diverging nozzles each having an aperture through which a fluid may flow and maintain the normal radius tube shape within the circular cross section along the entire tubular member.

2. The heat exchanger apparatus of claim 1 wherein said obstructions project into said tubular member until they contact one another.

3. The heat exchanger apparatus of claim 1 wherein said obstructions are spaced apart from one another by a predetermined distance.

4. The heat exchanger apparatus of claim 1 wherein said predetermined distance is between 0-12% of a diameter of the tubular member.

5. The heat exchanger apparatus of claim 1 wherein said opposing pairs of obstructions are located along the sides of said tubular member such that when said tubular member is viewed from one end, said pairs of opposing obstructions are disposed at an angle relative to the vertical axis of said tubular member.

6. The heat exchanger apparatus of claim 5 wherein said obstructions are located at a 45° angle relative to said vertical axis of said tubular member.

7. The heat exchanger apparatus of claim 5 wherein said obstructions are located on an axis oriented at an angle of between 0 and 45° relative to said vertical axis.

8. A heat exchanger apparatus comprising an inshot burner and at least one single piece tubular member having a generally circular cross section, said tubular member further comprising a restricting and turbulating structure integral to said tubular member and disposed within said tubular member, said restricting and turbulating structure comprising at least one pair of opposing indentations having a generally parabolic dimple shape extending into said tubular member until said indentations confront one another, the entirety of said opposing indentations of a pair being aligned with respect to each other, said pairs of opposing indentations disposed within said tubular member to form a pair of adjacent converging, diverging nozzles.

9. The heat exchanger apparatus of claim 8 wherein said obstructions project into said tubular member until they contact one another.

10. The heat exchanger apparatus of claim 8 wherein said obstructions are spaced apart from one another by a predetermined distance.

11. The heat exchanger apparatus of claim 8 wherein said predetermined distance is less than 13% of a diameter of the tubular member.

12. The heat exchanger apparatus of claim 8 wherein said opposing dimples are disposed within said tubular member at an angle with respect to a vertical axis of said tubular member.

13. The heat exchanger apparatus of claim 12 wherein said obstructions are located at a 45° angle relative to said vertical axis of said tubular member.

14. The heat exchanger apparatus of claim 12 wherein said obstructions are located on an axis oriented at an angle of between zero and forty-five degree relative to said vertical axis.

15. The heat exchanger apparatus of claim 8 wherein said tubular member is bent into a serpentine shape.

16. The heat exchanger apparatus of claim 8 comprising a plurality of said tubular members.